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ABSTRACT

This thesis reports on a study of the use of first and second languages among students of a Spanish immersion program. Eight fifth- and sixth-graders with varying levels of Spanish proficiency participated in the study. Data were collected through student verbal reports, questionnaire-based interviews, classroom observations, and background information such as school grades and achievement test scores. The study found that although students used Spanish when talking to the teacher in teacher-fronted classrooms situations, they were unlikely to use Spanish when talking to fellow students, unless the students were working on an academic task. Learners were able to understand written and verbal instructions in Spanish, especially if these instructions were over material easily grasped. However, learners had more difficulty understanding instructions in Spanish if the material was new or difficult for any reason. (Contains 41 references.) (MDM)

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ED 372 622

Language Use in Full Immersion Classrooms: Public and Private Speech[1]

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Summa Thesis

January 1994

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[1]I give my heartfelt thanks to the Principal of the Adams School, Dr. Luz María Serrano, for graciously agreeing to let us conduct the study at her school. I would also like to thank the teachers, in particular Jane Berg and Lori Dragert, for allowing me to come into their classrooms and for sharing their insights into the immersion education process. I would also like to thank all of the pupils for their continued cooperation over the five months of the study. In addition, I would like to extend all my thanks to my advisor, Dr. Andrew Cohen. Without his vision, insight, and experience, this project would have been impossible. I would also like to thank the other members of the research team - - - Jim Parker, Amy Fjerstad, Lisa Babbs, and Karen Moline - - - whose continual support and insights throughout the study made the project possible. I would particularly like to thank Jim Parker for generously sharing his thoughts on language use in the immersion classroom during our many discussions over the course of this research. Finally, let me thank those professors and colleagues whose constructive comments contributed greatly to this paper - - - Elaine Tarone, Carol Klee, and Doria Ransom.

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INTRODUCTION

Language immersion programs, in which learners study part to all of their course content in a non-native language, have become an increasingly popular form of elementary and secondary education in Canada and the United States over the past twenty years. These programs are based on the assumption that second language acquisition (SLA) occurs most easily and rapidly in the target language environment and culture. To some extent, immersion programs attempt to duplicate native-like learning conditions by surrounding learners with the target language and exposing the learner to the target culture as much as possible. Recent research on full immersion programs has shown that learners make normal to better than normal progress in subjects that are taught through a second language (Swain 1992, Genesee 1987, Cohen & Swain 1979).

Although learners also appear to have achieved a level of functional proficiency in the target language, there also appear to be clear gaps in learners' second language skills. Research on French immersion programs in Canada have shown that while learners have very good receptive skills, specifically, listening and reading, they "remain well behind francophone peers in the productive skills of speaking and writing (Swain 1992: 644)." Even after receiving many years of comprehensible input, learners in the French immersion programs produce spoken and written French which deviates from native-speaker norms morphologically, syntactically, and lexically (Genesee 1987).

Immersion learners may fail to fully acquire the system of the target language due to deficient or inappropriate input. The language used by immersion teachers, due to the nature of the immersion classroom, may be functionally restrained, providing learners with little modeling of such forms as politeness markers or the conditional (Swain 1985). Swain, however, is quick to point out that little data have been collected on the nature of teacher-talk in immersion classrooms and suggests that few conclusions can be drawn until more research in this area has been conducted (1985). Swain & Carroll (1987) and Swain (1991) point to feedback as another area of teacher input that may be underutilized in the immersion classroom. They observed that teacher feedback to

learners in the form of error correction, either explicit or implicit, was inconsistent and infrequent. Swain (1991), however, also points out that teachers have few guidelines in this area, as there has been little work determining which error correction strategies might be most effective for them to use.

Immersion learners may also fail to achieve native-like proficiency because they are not forced to produce sustained, native-like discourse. In research conducted on teacher-fronted full immersion classroom situations, Swain (1991, 1985) and Swain & Carroll (1987) have suggested that immersion learners' difficulties may result from a lack of opportunity to use extended discourse. Swain proposes that "opportunities to produce sustained output in the second language are crucial to the second language learning process" because they provide " . . . opportunities for variety and complexity of language use" and because they force " . . . the learner to pay attention to how content is expressed", i.e. to pay attention to producing the correct form of the language (1991: 237). In Swain and Carroll's (1987) study of more than ten immersion classes, they found that in teacher-fronted situations learners were producing utterances that were longer than a clause only about 14% of the time. Their findings support the hypothesis that learners in French immersion programs may not be getting enough chance to produce "sustained talk" in teacher-fronted situations.

Learners may have little pressure to conform to target language standards in small groups or non-teacher fronted situations, because they can speak the target language in a non-native way and their peers will still understand them (Swain 1985). R*elexification,* a form of negative transfer, may occur when pupils use English language structures but substitute foreign language vocabulary when using the target language. Or, learners may use target language structures but substitute English words into their utterances if they do not know the vocabulary in the target language. Coming from a common language background, learners may find these non-idiomatic target language forms of their peers completely acceptable. Essentially, learners may not have the ability or motivation to provide feedback to their peers, in terms of comprehension or clarification checks, in the way a native speaker would be able to. Learners may end up reinforcing and possibly even encouraging non-idiomatic language use with each other. As a result, pupils' language ability may

fossilize at a level which is sufficient for an immersion classroom situation but which is not native-like. This may be particularly true if the immersion program is situated in an area where the target language demands outside of school are limited. However, little research has been done on the nature of the target language immersion learners use with each other in non-teacher-fronted situations.

Another detriment to learners' target language acquisition may occur if learners speak the native language with each other instead of speaking the target language. However, few studies on immersion programs have documented the extent to which learners actually use the native language versus the target language in the classroom. Cohen and Lebach, in their 1974 study on the Culver City immersion program, reported that the second graders in that program reported using English about half of the time in the classroom. This was in a program where teachers took extreme care to stay within their second-language guise and where separate teachers taught the native and target languages in the upper grades. However, no observational data were collected on learners' language use in that study.

Researchers of the French immersion programs in Canada note that learners seem to use a lot of English with each other. Swain commented on her research, " . . . my own informal observations indicate that most peer-peer interaction that is not teacher-directed is likely to occur in English rather than in French . . . (1985: 246)." Again, however, there was no systematic observational data collected in that study. In fact, there seems to be few recent studies which address the extent to which learners use the native and target language in the immersion classroom, especially in non-teacher-fronted situations (Swain, 1993, personal communication). Therefore, although learners in immersion programs are continually surrounded by the target language in theory, they may not actually be surrounded by the target language as much as teachers and administrators think they are.

Another area in which learners may not be totally surrounded in the target language is while they are performing verbal cognitive tasks. Although the assumption in immersion education is that learners are only able to gain proficiency in the target language because they are "thinking" in

the target language, systematic gaps between immersion learners' receptive and productive skills may be occurring because learners are reluctant or unable to "think in the target language".

While learners perform certain cognitive operations non-verbally, using symbols and relationships, they also perform many operations verbally. Verbal cognitive operations can take the form of inner/private speech, that is, speech directed primarily towards one's self, or they can take the form of social/public speech, that is, speech directed partially or wholly towards others. Private speech, characterized by Vygotsky as "speech almost without words (1986: 244)", is severely simplified compared to public speech, governed by predicates, and often not understandable because referents are unclear. Vygotsky (1986) writes that, "In inner speech . . . a single word is so saturated with sense that . . . to unfold it into overt speech, one would need a multitude of words (247)." In order for private speech to be understandable to others, that is, become public speech, it becomes increasingly structured. [2]

Understanding the extent to which immersion learners perform cognitive operations in their native or target language during the processing of classroom tasks may help us understand SLA processes better by providing insights into learners' real involvement with the target language. In addition, assessing the extent to which learners use the native and target languages with each other is also an important step in understanding language learning processes in immersion programs.

The following pilot study was designed looks at these two issues by examining the nature of the internal language environment that emerges in learners in the context of the external language environment found in immersion classrooms. Using the learner as the locus of reference, the *internal language environment* refers to how learners process language in their minds - - - that is, their native- and second-language systems and the role played by each in performing the cognitive tasks which accompany second-language use. The *external language environment* [3] is defined as all language-related elements that influence the learner from without, namely, curriculum goals,

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[2] Both inner/private speech and social/public speech can be silent, sub-vocalized, or aloud. That is, private speech can be externalized and public speech can be silent. However, private speech does not tend to be externalized unless prompted, through such procedures as verbal reports.

[3] The extremely useful concepts of the *internal language environment* and the *external language environment* in relation to immersion education were developed by Dr. Andrew Cohen and Jim Parker.

classroom policies and procedures, classroom materials, the nature of classroom activities, and communicative exchanges between learners, teachers, and administrators. These influences can occur either in the native or the target language.

This paper will address the following questions concerning the internal language environment that emerges within the specific external environment of an immersion education program:

1. External Language Environment:

   To what extent do native-English-speaking learners use their L1 (English) and L2 (Spanish) to communicate with teachers and peers in a Spanish full-immersion classroom?

2. Comprehension Processes:

   A. To what extent do learners in a Spanish full immersion program use their L1 (English) and L2 (Spanish) in the comprehension of written and verbal instructions of mathematics?

   B. At what moments do learners switch languages, either from the L2 to the L1 or from the L1 to the L2, in the comprehension of written and verbal instructions of mathematics?

3. Production Processes:

   A. To what extent do learners use their L1 and L2 in performing the cognitive operations necessary to solve both numerical and verbal mathematics problems?

   B. During what tasks or learning moments related to the cognitive processing of mathematics do learners switch languages, either from the L2 to the L1 or from the L1 to the L2?

DESIGN OF THE STUDY

A. Sample

The learners studied were part of a larger study conducted in a Spanish early full immersion school in the Twin Cities area. In the larger study, which was designed to explore cognitive processing across grade levels, thirty-two learners were selected - - six at grade 3, seven at grade 4, nine at grade 5, alnd 10 at grade 6. The study chose learners from grade 3 and upwards because previous research by Cohen (1987a, 1992) and Garner (1987) indicated that learners above grade 3 were capable of providing reliable verbal report data.

The learners were selected by their teachers and were intended to represent learners at three levels (high, medium, and low) of both Spanish language proficiency and academic achievement. The Spanish language proficiency ratings were based on the teacher's rating and on the standardized test, La Prueba Riverside de Realización en Español (Riverside Publishing Company, 1964).[4] The academic skills rating was based on the teacher's rating and on the standardized test, SRA Survey of Basic Skills (Science Research Associates, 1985).[5]

For all of the learners I studied, the teacher's rating of academic achievement and Spanish language proficiency were the same, in other words, a learner rated average in language proficiency was also rated average in academic achievement. However, for several other learners in the study the ratings on Spanish language proficiency and academic achievement sometimes differed, e.g. one learner rated high in Spanish proficiency was also rated medium in academic achievement. Although some learners in the immersion program were native speakers of Spanish, all subjects in this research project were native speakers of English. Learners' participation in the study was voluntary.[6]

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[4] Subtests included in this test are reading (reading comprehension, vocabulary, study skills), language (grammar, capitalization, spelling, punctuation), and mathematics (math computation, math problem solving).
[5] Subtests included in this test are: vocabulary, reading comprehension, mechanics, usage, spelling, mathematics (computation, concepts, problem solving), reference materials, social studies, and science.
[6] Both parents and students signed consent forms.

I studied eight learners from the 5th and 6th grade classes - - three from the fifth grade and five from the sixth grade, chosen according to the criteria above. The majority of the data reported on will be from these learners; however, some data reported on was collected by another researcher who worked in the same fifth and sixth grade classrooms. These data will be marked accordingly.

B. Schedule of Observations

Beginning in December, 1992, I visited one of the fifth-grade and the only sixth-grade classroom in the St. Paul immersion program, to observe language use patterns of learners in the classroom, to ask learners questions about their language of thought, and to collect verbal report protocols. After several initial visits in December, I visited the school regularly from January to April. I generally visited the school twice a week, for an hour or two at a time in the morning. The amount of time spent collecting non-participant observation data and the amount of time spent collecting verbal report data from individual learners or groups of learners depended on the classroom acitivity that was going on at that particular time. During teacher-fronted periods it was difficult to collect verbal report protocols, so these were collected during less structured periods in the class. In January more non-participant observation data was collected because the classroom activity was often teacher-fronted during the time I observed. In February, March, and April, when I was more familiar with the schedule, I attempted to come during periods in the day when the learners had more free time, in order to work with them individually to collect verbal report data. The amount of time that I interacted with each learner depended on the work that the learner was doing and how talkative the learner was.

C. Researcher Characteristics

Since non-participant observation and verbal report research techniques implied a significant amount of researcher interaction with the learners and the learning environment, it is necessary to describe my own characteristics and approach as a researcher and data collector. I was a twenty-one year old female undergraduate student at the University of Minnesota, pursuing

a degree in linguistics. I was a native English speaker. I had studied German for eight years, and I had taken a year of Spanish in high school.

One of my goals as a researcher was to be the least disruptive and non-manipulative as possible. Consequently, I tried to build a rapport with all of my learners, so that each of them could feel comfortable talking to me, doing their classwork around me, and externalizing their private thoughts while doing a task. At the onset of the study, I had an initial interview with each learner where I asked for their help, explaining that the information we were looking for could only be provided by them and that we were asking them questions to improve immersion education in the future. I explained the nature of the study, in other words, that we were interested in the language that they were thinking while doing their work. I then explained the methodologies I would be using, that is, that I would be sitting next to them while they were doing their work and asking them to talk out loud. I explained to each learner that I would be tape recording them, but that these tapes were confidential, as was anything else they said to me.

I also tried to balance the two goals of working with all of my learners and staying with one learner for a sufficient length of time to get externalized cognition. Sometimes this meant that I worked with all of my learners each time I visited, and sometimes this meant that I worked with only one or two learners per visit. However, if I worked with a certain set of learners during one visit, then I tried to work with the other learners on the following visit.

D. Setting

In order to understand how learners work in the immersion classroom setting, it is necessary to describe the classroom environment itself, including: the teachers and teacher's aides, the physical setting of the classroom, and the general nature of classroom activities.

1. Teachers, Teacher's Aides, and AMITY Aides

The teachers in both the fifth- and sixth-grade classes were non-native speakers of Spanish and native speakers of English. Both of these teachers had studied Spanish in college and spent time in Spanish-speaking countries. In addition, the sixth grade teacher had spent a

number of years teaching in bilingual education programs in the border towns of the Southwest United States.

All teachers in this immersion program taught both the Spanish and the English sections of the day. This aspect of the immersion program differed significantly from the ideal immersion program, where different teachers teach the native and target language in order to preserve the language guise of the teachers. In an ideal immersion program learners have a monolingual Spanish relationship with the Spanish teacher and a monolingual relationship with the English teacher. It is important to keep in mind that the learners in this program essentially had a bilingual relationship with their teacher, certainly a possible influence on the language use of both teachers and learners.

In both the fifth and sixth grade classrooms the teacher was assisted by an amity aide who was a native speaker of Spanish. The amity aide helped pupils with their work and corrected papers. The same amity aide worked in both the fifth and sixth grade classes that I studied. In the sixth grade class, there was also a student teacher in addition to the amity aide. The student teacher, a native speaker of Spanish from Chile, taught various sections of the class, including but not limited to: math and social studies. She also helped learners with their work in class. Both the amity aide and the student teacher seemed to make a point of speaking Spanish with the students; however, they also sometimes responded (in Spanish) to questions that were asked in English.

2. Physical Setting

In both classrooms I studied, pupils' desks were grouped into sets of four, so that each learner sat next to one learner and faced two other learners. This classroom arrangement reflected the teachers' commitment to teaching philosophies which encourage group-work learning situations. This classroom set-up effectively promoted group work - - learners seemed to work together on many tasks they were assigned, although they also worked individually.

3. Teacher-Fronted Classroom Situations

Classroom activity seemed to fall into two types: teacher-fronted and non-teacher-fronted. In a teacher-fronted situation situation the classroom activity was in a lecture-style format where the teacher explained parts of the text and then asked learners questions. Classroom discussion in this format followed a pattern of classroom discourse discussed in Ellis (1987) that appears to be fairly typical of content classrooms. Researchers from the University of Birmingham have labeled this pattern of classroom discourse "initiate-respond-feedback (IRF)". That is, the teacher initiates by asking a question, a learner responds, and the teacher gives some form of feedback (Ellis, 1987: 146-147). Swain (1991) gives an excellent summary of this type of classroom interaction:

> " . . . teachers work through a content lesson by asking a lot of questions about something they have presented before, or that the learners have read before. The teachers ask questions with particular answers in mind; learners' responses are fairly short and to the point. . . . Diversions from the main theme of the lesson arising from personal experiences or insights tend not to occur (236)."

During this kind of teacher-fronted situation in the immersion classroom, learners tended to talk to the teacher but not among themselves, and they generally stayed in their seats. However, students sometimes talked among themselves, in whispers or low voices, even during a teacher-fronted situation.

4. Non-Teacher-Fronted Situations

However, teacher-fronted situations were not the only type of classroom situation observed. Learners were also given time during the day to finish up old material and to work on projects or new material. During these non-teacher-fronted situations, learners worked alone or in small groups. They talked freely with each other and walked around the classroom or stayed at their desks as they needed to.

5. Activities Outside the Main Classroom

Learners also participated in many activities outside of their main classroom such as: going outside for recess, going to music or to gym, and going to lunch. As all of my research was conducted in the main classroom, I collected little data on language use outside the main

classroom. However, other researchers did accompany some learners to recess, lunch, music, and gym, providing data on language use in these areas. In addition, pupils' own comments on their language use also provided data regarding learners' language use outside the main classroom.

E. Instrumentation

1. Verbal Report

In order to describe the learner's internal environment, *verbal report* procedures (Cohen 1987b, 1991) were used to collect data on learners' use of their native and foreign language in performing cognitive operations for solving math problems. More specifically, verbal report procedures include: *think-aloud* (externalizing verbalized thoughts in conjunction with something specific one is doing, without analyzing what one is doing), *self-observation* (introspecting about current thoughts and/or retrospecting about something specific that one is doing, has just done or has done at some earlier time), and *self-report* (indicating what one tends to do, without referring to any specific cognitive activity).[7]

2. Questionnaire-Based Interviews

All learners were interviewed initially to elicit self-report data on their abilities, attitudes, and preferences about thinking in Spanish and about using Spanish in speaking with their peers and other adults. Some of the questions that were asked included: Why are you in an immersion school? Do you think that it is important to think in Spanish? How well do you think you speak Spanish? Do you ever run into problems when using Spanish? What kind? When? What do you do when you have a problem in Spanish? Do you use Spanish with teachers? Peers? Do you ever use English? Is it easier to use Spanish or English?

3. Classroom Observation

[7] A typical verbal report may contain elements of all three types of reporting, but respondants in the study were encouraged to do less self-report and more externalization of thoughts on tasks currently being executed or that were just recently executed.

Non-participant classroom observation was used to obtain data regarding the external environment, particularly: language use patterns in whole-class, group, and paired interaction -- that is, who said what to whom, in what language, and under what circumstances.

4. Background Information

Archival data from the school files were used in order to obtain Spanish language proficiency scores (La Prueba Riverside de Realización en Español) and scores for performance on academic skills (the SRA Survey of Basic Skills), as well as the learners' school grades.

F. Data Collection Procedures

1. Verbal Report Protocols

I was one of four University of Minnesota undergraduate investigators and one postgraduate investigator who collected data over a five-month period from December 1992 to April 1993. In order to collect verbal report data, I sat with learners during class and asked them questions about what they were working on at that moment. Occasionally they were already externalizing their private speech and I simply observed and recorded the language in which they were doing the work. Most often they worked silently and were prompted to speak out loud, through the use of such phrases as: Could you do your work out loud? Could you talk out loud? After learners finished with a problem, they were asked questions about what language they used when they paused or when they did their work silently while completing a problem; they were also asked why they were using English or Spanish. If learners had just finished a task, they were asked what language they thought they had been using during the task and why. If learners were not working on any current task, they were asked to re-solve problems they had solved previously.

Learners were also asked questions on the instructions to their tasks. In terms of written instructions, learners sometimes were asked to translate the instructions in order to see if they had any problems understanding the instructions. They were also asked questions about what language they understood the instructions in, that is, whether or not they understood them directly in Spanish or whether they had to translate all or part of the instructions into English.

They were asked questions about what language they were thinking in if they got stuck or had trouble understanding the instructions. In terms of spoken instructions from the teacher, learners were asked if they understood what the teacher was saying at the time she was saying it, and if they understood it straight in Spanish or if there was a "little voice in their head" translating it back into English. They were asked to comment on the instances they had problems understanding spoken instructions.

Because the research group felt it would be easier for learners to be prompted by questions in their native language and because I am a native speaker of English with little experience with Spanish, all questions were asked in English. However, even though all the questions asked of learners were in English, learners were encouraged to provide their verbal reports in whatever language they felt most comfortable in at that moment, as they worked on tasks like: solving numerical and word problems, working on social studies, and writing compositions.

Although some data was collected on learners' use of language in teacher-fronted situations, most of the data collected on the nature of cognitive processing was from situations where learners were working in non-teacher-fronted situations, because verbal report data collection techniques were least disruptive to the class in that setting. A significant part of the data collected was on learners' use of language while solving mathematics problems, both numerical and verbal, because that is what learners were working on when I was able to visit the classes. A limited amount of data was also collected regarding learners' language use while performing tasks in other academic subjects, particularly in composition and social studies. This thesis, however, will only consider problem-solving processes of mathematics, as that was where the bulk of the data was collected.

2. Questionnaire-Type Interviews

During individual interview sessions, learners were asked general questions about which language they used in doing their work and in interacting with other learners and teachers. They were questioned about where they got stuck when they used Spanish to perform classroom tasks

or converse with peers or teachers; they were also asked about what strategies they used to overcome these difficulties. They were also asked about areas where they had difficulty understanding verbal or written instructions. These interviews with learners were conducted in English and tape-recorded.

3. Classroom Observation

Data was collected on language use in and outside of the classroom. It was marked for the situation the data was collected in, either teacher-fronted or non-teacher fronted, as well as whether the discourse was task-oriented or social-oriented. The identities of the participants in a conversational exchange and the language of use were noted. Some of the teacher-fronted activities in the classroom were also tape-recorded.

4. Reliability and Validity

Several factors lend reliability and validity to the results obtained. Over the five months of the research project, I interacted with the same group of learners on a repeated basis. Because learners were observed over a long period of time, they got to know and trust me and realize that they could tell me what they really felt was going on and not what they thought I wanted to hear. Also, less extroverted learners had a chance to warm up to answering questions.

In order to make learners feel more comfortable speaking Spanish with a native English speaker, learners were made aware that the conversations were being tape-recorded and were reminded that if they spoke Spanish someone would translate their comments later, if necessary. They were also verbally encouraged to use Spanish if they wanted to. In addition, I was working with another researcher who was fluent in Spanish, and he was able to help me clarify what was happening during initial visits to the classroom. Even better, since learners sometimes spontaneously externalized their inner thought processes while solving a problem, some non-participant observation data was collected on learners' cognitive processing. This data on cognitive processing might be the most reliable because it was not elicited through verbal prompting of any sort, although it is certainly true that my presence itself may have served as a prompt for externalization or language choice.

G. Data Analysis Procedures

1. Verbal Report Data

Written transcriptions of all tape-recorded verbal report data were made. These verbal report data were then organized by subject matter, (e.g. math, science, reading, etc.) and the language of verbal cognition used, (e.g. Spanish, English or a combination of the two). Learner explanations of language use were also analyzed to find motivations behind language use. All data were also coded according to the type of verbal report data it was: think aloud, self-observation (introspective and retrospective), and self-report, as previously defined.

2. Non-Participant Observation Data

In order to understand the nature of the language use of students and teachers in various contexts, non-participant observation data was tape-recorded and written transcriptions were prepared from the tapes. Using Schlegloff and Sack's (1973) concept of **adjacency pairs**, instances of learner and teacher language use in the classroom were counted. An *instance* is defined as a speech set that includes, but is not limited to, at least one adjacency pair. Thus, an instance includes at least one utterance (of any length) from one speaker and another utterance from a second speaker. An example of a an instance is a teacher's question to a learner and the learner's response to the teacher. While some instances recorded were only one adjacency pair, other instances were composed of many adjacency pairs.

Each instance was then coded according to the following criteria: language use (English or Spanish); the type of classroom situation where the instance occurred (teacher-fronted or non-teacher-fronted); and the task orientation of the situation (task or social).[8] The comparison between learners' use of Spanish and English in teacher-fronted, task-related and social situations and learners' use of Spanish and English in small group, task-related and social situations is presented in Table 1 below.

[8] During the course of our discussions on this research project, Jim Parker graciously suggested that I might productively use the concepts of teacher-fronted situations versus non-teacher fronted situations and task-oriented discourse versus social discourse to perform a sociolinguistic analysis of this data.

Some non-participant observation data that was not tape-recorded was also collected. This data was also written up and analyzed with the data above.

3. Questionaire-Type Interview Data

Written transcriptions of initial interviews with learners were also prepared. These data were analyzed to find learners' motivations for language use in a particular situation, either in communicating with other people in the classroom or when doing their work.

RESULTS

In the following sections, learners' use of language in the classroom with their peers and teachers, and their of use Spanish and English during the comprehension and production aspects of solving mathematical problems, are presented. The first section deals with the language(s) learners use in talking to teachers and their peers in teacher-fronted and non-teacher-fronted situations. The second section deals with the language(s) learners use to understand instructions to mathematics problems, both written and verbal, and the third section deals with the language(s) learners utilize to solve mathematics problems.

In all quotes from learners, grade (5 or 6), academic achievement (H,M,L) and Spanish language proficiency (H,M,L) will be indicated after the learner's name (pseudonyms). Therefore, the sixth grade learner Todd, of average academic and Spanish language achievement would be marked in the following way: Todd (6M/M).

A. Language Use in the Classroom

Non-participant observation data on learners' language use in the classroom is summarized in the following table. Each line reflects the number of instances of language use that were collected in that context. Each instance was at least one adjacency pair, but it is important to keep in mind that many instances were much longer than one adjacency pair. For example, some instances in English went on for many minutes; whereas others in English or Spanish were very short. Thus, the percentages given are not a reflection of the actual time spent in a language, because each instance was not the same length of time.

Table 1
Language Use in 5th and 6th Grade Immersion Classrooms

Social and Task-Oriented, Teacher-Fronted Situations

Language	# of Instances	% of Instances
Spanish	7	70%
English	3	30%
Total	10	100%

Social and Task-Oriented, Small Group Situations

Language	# of Instances	% of Instances
Spanish	4	22%
English	14	78%
Total	18	100%

Teacher-Fronted, Task-Oriented Situations

Language	# of Instances	% of Instances
Spanish	7	88%
English	1	12%
Total	8	100%

Small Group, Task-Oriented Situations

Language	# of Instances	% of Instances
Spanish	4	27%
English	11	73%
Total	15	100%

In the following sections, the trends of language use in the fifth and sixth grade immersion classrooms that emerged from non-participant observation techniques will be explored. Verbal report data and interview data from learners that pertains to language use in the classroom will also be presented in these sections.

1. Spanish Use in the Classroom

a. Small Group vs. Teacher-Fronted Setting

Learners in the fifth and sixth grades reported using Spanish with their teachers and very occasionally with friends in this full immersion program. As we see from the results in Table 1, non-participant observation results tended to confirm learner reports about their own behavior. There was a clear preference for speaking Spanish in a task-oriented, teacher-fronted situation (7

of 8 instances). On one occasion in the sixth grade, a learner switched over from English to Spanish[9] in the middle of a statement in order to comply with this sociolinguistic rule, as seen in the following data:

> Ex. 1: Donna (6 M/M) was asked a question about how she had worked out the math problem by the student teacher, a native speaker of Spanish from Chile.
>
> Donna responds: If the fraction's not - - **si no está en forma simple.**

Learners also used Spanish in small group, task-oriented situations, although they used it to a much lesser extent than in teacher-fronted task-oriented situations - -27% of the instances in small-group situations compared to 86% of the instances in teacher-fronted situations.

b. Task- Related vs. Social Interactions

Even though learners used Spanish in small-group situations, they did not seem to use it equally for both task-related and non-task related purposes. Despite the fact that few social uses of either language were noted overall (5 instances of English), it is important to note that no social use of Spanish was observed in this full immersion program in the fifth and sixth grades. This finding differs from Cohen and Lebach's research on second graders in the Spanish early full immersion program in Culver City, CA, that "There were no particular things that they said in either Spanish or English . . . children used Spanish and English in free variation in the classroom (1974: 39)." In these fifth and sixth grade immersion classrooms, Spanish seemed to be used by learners to perform academic tasks rather than talk to their friends socially.

2. English Use in the Classroom

Learners reported using English during the English part of the day, during lunch, during recess (even during recess in the Spanish part of the day), and with their friends in

[9] All responses given in Spanish will be marked by **bold-faced** type.

general. These reports are similar to findings in other immersion programs, where learners report using English half of the time (Cohen and Lebach: 1974).

a. Small Group vs. Teacher-Fronted Setting

Non-participant observation seemed to show that English use tended to be among learners, in teacher-fronted and non-teacher fronted situations. Learners almost never used English with a teacher in a teacher-fronted situation. On the one occasion that the use of English with a teacher was observed in a teacher-fronted situation, the use of English was clearly inappropriate, signalled by the gasps of surprise and muffled laughter of classmates.

> Ex. 2: The sixth grade class was correcting a spelling test. The teacher called on learners to spell words out loud, using the Spanish alphabet. A learner was having difficulty spelling the word **jornada** - 'a working day, a day's journey'. In order to spell the word, he said, "**Hache, oh** - - no, I mean **ge oh** - - . Then learner then simply reverted to English and said "jay (j)".

When the learner did this, the whole class erupted into laughter or talking, indicating the inappropriateness of this response in the English alphabet.

b. Task-Related vs. Social Interactions

Whereas Spanish seemed to be used only for task-related activities, English was used for both task-related and social functions. It is also important to note that while learners did use Spanish on task-related activites, learners used English to a much greater extent than they used Spanish. While I recorded only 4 instances of Spanish used in a small group, task-related activity, I recorded at least 11 instances of learners using English in the same environment, nearly three times the number of instances of Spanish. These findings suggest the general trend that even though Spanish was used among learners in small group settings, English was used to a much greater extent. This conclusion is supported by learner self-report data - - one sixth-grader, Halena (6H/H), commented, "Well, most people in our class, when they work together they just talk . . . in English."

Learners thus tended to follow the sociolinguistic rules outlined above: Spanish with teachers in teacher-fronted situations and sometimes on task-related activities in small group work; English with classmates in non-teacher-fronted situations for work and social purposes.

B. The Language of Comprehension Processes

1. Verbal Instructions

a. Unfamiliar Vocabulary or Mathematical Concepts

Learners in these fifth and sixth grade immersion classes seemed to have little difficulty understanding verbal instructions that were routine or familiar, but they ran into trouble with explanations about new or complicated material and when the teacher used unfamiliar vocabulary. Karen (6H/H) pointed out two key difficulties of understanding the teacher's instructions in Spanish, namely. vocabulary and speed. While responding to the question "How about your teacher's instructions, do you generally understand those?", she said:

> Ex. 3 Yeah, she really puts them quite simply, but sometimes when they're calculations or step-by-step things -- they'll get a little confusing if she goes really fast or if she uses those big words I don't understand.

Karen (6H/H) also mentioned that she had difficulty comprehending when she was being taught unfamiliar concepts in math. She says,

> Ex. 4 Sometimes if I don't understand it, it'll seem like I can't understand what she [the teacher] is saying. So like if she's explaining a new type of math or science calculation, and I don't understand it, it'll seem like her instructions aren't making sense. Even though they're clear to me, [or] they would be if I understood, . . . if I don't understand, they're not clear, because I'm so distracted by the other problem [figuring out the math and not the language], because that's the big assignment.

In this case, even though Karen (6H/H) could understand the Spanish, she had a difficult time following the teacher's instructions because she did not understand how to do the math. Consequently, she could not follow the Spanish either.

b. Difficult Cognitive Operations

Again, in relation to mathematics, learners across the spectrum of academic ability and Spanish proficiency mentioned the difficulty of understanding the teacher's directions if the material involved complicated cognitive operations. Cynthia (6L/L) said that it was hard to understand when she heard explanations about math in Spanish, but when she saw someone do it she understood. She said that "Other kids say it in a new way and then everybody understands." (In my classroom observations I noticed that other learners' explanations to Cynthia were in English.) Karen (6H/H) also pointed out that if the explanation involved operations that were complex or cognitvely difficult, it was difficult for her to understand the teacher; thus suggesting that learners of all levels have difficulty understanding the teacher if they find the problems difficult.

However to some extent, what was difficult seemed to depend on the individual abilities of the learner. Whereas Karen (6H/H) said that she only occasionally had difficulties understanding the teacher, usually had no problem successfully completing assignments, and often was approached by other learners for help; Cynthia (6L/L) seemed to have difficulty correctly solving problems the times she was observed and often needed help from other learners.

2. Written Instructions

The fifth and sixth grade learners in this full immersion program also seemed to understand the written instructions of math problems to a great extent in Spanish, especially when these instructions covered tasks with which the learners were familiar or which they considered routine. Instructions for numeric problems fall into this category. Learners seemed to have no problem with instructions like:

Da el producto en forma simple.

'Give the product in reduced form'

However, with word problems, which involve translating verbal instructions into numeric concepts (Cummins, D.D., Kintsch, Reusser, and Weimer 1988), learners seemed to have difficulty understanding the problem when it involved difficult cognitive operations or had

unfamiliar vocabulary. In these situations, learners dealt with these difficulties in a couple of different ways.

a. Stay in Spanish

Karen (6H/H) said she sometimes used strategies that allowed her to keep thinking in Spanish.

> Ex. 5 Researcher: What happens when you're having a problem with a math problem? . . . What language do you think you think in first when you get stuck?
>
> Karen: Spanish! I'm trying to go through my vocabulary, to see if there's any word that's similar, and get the definition of that word, and see if it relates.

b. Translate to English

However, other learners dealt with difficulties by translating all or part of the instructions into English. Todd (6M/M) made this comment about word problems, "I usually do it in Spanish, but if there's something I don't understand, if it's a complicated problem, I'll try to translate it in my mind into English." The data presented in the following sections illustrate some of the key situations where difficulties seemed to cause learners to translate all or part of the instructions into English.

1. Lack of Vocabulary

Learners sometimes had difficulty understanding the directions on a problem because they did not understand some of the vocabulary. For example, Ana (6M/M), a sixth grader, had difficulty with a particular word problem because she did not understand one word - **ahorras** ' to save". In her words, "That word pretty much gives the problem away. If there's like one word in there and it looks like it's the key word, then it's really, really, really hard [to solve the problem] if one doesn't know the word." Rather than going to a dictionary to find the definition of he crucial Spanish word, however, Ana (6M/M) switched into English in order to reason out the logic of this problem without the missing word. Of this process she said:

> Ex. 6 Well, I just took out the little clues, and said like, 'How much money would - - I was just sort of guessing what it [ahorras] meant - - if you bought something. It's like, you add something together and then you come up with the answer and then you minus what you save [to come up with the final answer].

2. Difficult Cognitive Operations in the Problem

However, learners also translated instructions into English because the cognitive operations involved in the problem were difficult. When Peter, a fifth grader of medium academic and Spanish language achievement was asked:

> Ex. 7 When you read these instructions do you understand right away what it says in Spanish or when you read them do you think words in English?
>
> Peter said: I try and get them into English, so I can understand them a little bit better.

Of course, what learners found difficult to understand depended on both the general academic ability/Spanish proficiency of the learner and on the difficulty of the problem itself.

3. Individual Ability: Low/Low Academic and Spanish Achv't

Learners with a high level of academic ability and/or Spanish proficiency seemed to have little difficulty comprehending the main concepts of verbal math problems in Spanish, probably either because they understood the concepts directly in Spanish or because they were co-processing rapidly in Spanish and English.[10] However, other learners had to consciously translate from Spanish into English. This data, where Alberto (6L/L) worked on a word problem, was collected by another member of the research team, Jim Parker.

[10] The notion that learners may actually be co-processing in both languages was suggested to me by the following comment from Lambert and Tucker's research on French immersion education : " . . . (the) children may never have been on vacation at all. Instead they may have transferred basic skills of reading, concept development, word manipulation, and verbal creativity *through* French to English by reprocessing in English all the information they received through French, or by simultaneously processing in French and English (1972: 82)." A possible explanation for the reason high ability students fare so well in immersion programs is because they are extremely good at co-processing.

Ex. 8 Alberto was working on the following problem:

Ema, Marcos, José, y María tienen 9, 10, 11, y 13 años. José es mayor que María y menor que Ema. Marcos es menor que José y mayor que María.

¿Qué edad tienen [sic] cada uno?

'Ema, Marcos, José, and Maria are 9, 10, 11, and 13 years old. José is older than Maria and younger than Ema. Marcos is younger than José and older than Maria.

How old is each person?'

The researcher says: Can you talk to me about what you're doing? Are you thinking in Spanish?

Alberto: No. All I do is . . . I just read it in Spanish first, and then I just translate it in English and see what it means, and then just try to figure out the problem.

Researcher: Go ahead and try to work the problem out loud.

Alberto: Okay, Ema had nine years - was nine years old, and Marcos had - was ten years old. José was [pause] eleven years old, and Maria [pause] was 13 years old.

Okay. Um, José was older than Maria, and, and younger than Ema. So, older than Maria - was older than Maria [pause]

Oh! I get it! You have to figure out what was their age.

Here Alberto had to very consciously translate key ideas of the problem into English in order to understand what the problem was asking. Alberto's processing of this problem contrasted with the problem-solving processes of two high language/academic proficiency learners and one medium language/academic proficiency learner who worked on this same problem and completed the problem without translating the instructions.

4. Individual Ability: Med./Med. Academic/Spanish Achv't

Donna (6M/M) worked on the same problem as Alberto did above. Here is how she began solving the same problem. (This data was also collected by Jim Parker.)

Ex. 9 Donna: Right now I'm just copying the problem down. I usually copy it down before I read it through.

Researcher: Okay. Can you work through the problem out loud?

Donna: (read problem to herself) **Ema, Marcos, José, y María tienen 9, 10, 11, y 13 años. José es mayor que María y menor que Ema. Marcos es menor que José y mayor que María. ¿Qué edad tienen [sic] cada uno?** (Donna begins to work). **Marcos es menor que José,** okay that proves that Ema, um, **José es mayor que María y menor que Ema. Marcos es menor que José y mayor que María.** (reread from the problem). Okay, yeah, here - **aquí - se parece que Ema tiene trece años, porque nunca es menor que alguien, de los otros tres.** Okay, then, **después**, okay. **José es mayor que María y menor que Ema. Marcos es menor que José y mayor que María.** (problem is reread again). Okay, **mayor que María,** uh, I'm trying to think here.

Researcher: In Spanish or English?

Donna: I'm thinking in English. **José es mayor que María y menor que Ema,** Jose is older than Maria. Okay it looks like **Marcos es**, it looks like here that Jose is eleven, **Marcos es menor que** , hang on, and then here, 'cause it says "**menor que**" um, wait, "**Marcos es menor que José y mayor que María,**", which would make him ten, so Marcos is ten and then Maria is nine.

In this case, although Donna (6M/M) had to do at least some of the actual problem-solving processes in English, which may have involved working with the concepts in English, e.g. **José es mayor que María** became 'José is older than Maria', she understood the point of the problem directly in Spanish and even used the Spanish instructions to solve the problem. However, learners of high academic and Spanish achievement sometimes seemed not only able to understand instructions in Spanish but perform problem-solving processes in Spanish as well, as seen in the following section.

C. The Language of Production Processes

1.Spanish

a. Easy Cognitive Operations

Learners self-reported doing problems in Spanish, but little think-aloud data where learners performed cognitive operations in Spanish was obtained. However, in the following instance, Karen (6H/H) re-solved a word problem that she had done only moments before in

Spanish, providing retrospective self-observation data that she had done the problem in Spanish. When I came into the classroom, Karen was explaining to Carl in Spanish how she had done a certain math problem. Since I was too far away to tape-record this explanation, I went to Karen and asked her to explain to me what she had just explained to Carl.

> Ex. 10 Researcher: When you were doing this, were you thinking this in Spanish? Like how would you think this in Spanish, if you were going to think this in Spanish?
>
> Karen: Well, the same way I did it in English. Just figure out who is younger overall - -
>
> Researcher: Do you want to try that for me?
>
> Karen: **Ema, Marcos y José, y María tiene nueve, diez, once - - y - - trece años. José es mayor que María y menor que Ema.** (read aloud). **Entonces, tenemos ya María, María y después José y después Ema, en orden para el primer para - -** (unrecoverable data). **Después tenemos Marcos es menor que José y mayor que María. Entonces, si es más que José, mayor que María, Marcos es aquí. Entonces, tenemos, el orden y después** (Karen says a few more words; tape is unclear on what they are, but the language is Spanish). What I did was write them down in the order, and then figured out what went in between.
>
> Researcher: When you're doing these problems, are you thinking them in Spanish?
>
> Karen: This one I did in Spanish, because it was really simple, and there was no vocabulary at all, hardly.

In this case, we see that Karen was able to understand the instructions in Spanish and that she was also able to easily report how she had done the problem in Spanish. The fact that she was explaining the problem to another student in Spanish seems to point to the conclusion that Karen had been thinking about the problem in Spanish.

Other learners reported that they could do easy problems in Spanish as well, e.g. Ana (6M/M) reported that she solved easy numeric problems like :3 1/4+ 5 1/5 in Spanish.

b. After Spanish Prompt

Learners also solved problems in Spanish after reading the instructions aloud in Spanish. I had asked Ana (6M/M) to tell me how she had solved the math problems she worked on the day before.

Ex. 11 The researcher asked Ana about some math problems that she had worked on the day before. On the first problem, the researcher had her read the problem, then translate it, and then tell her how she had figured it out.

Problem: **Durante las vacaciones, Akim y su familia recorrieron en coche, 1,106 km en 14 horas. ¿Cuál fue el promedio de la distancia que recorrieron por hora?**

Ana's Translation: During the vacations of Akim and their family, the accomplished on - - in - - on car, one thousand one hundred and six kilometers in fourteen hours. What were the average of the distance they ran per hour?

Researcher: How would you figure this problem out? You can do it in Spanish or English, whatever language you think you would do it in.

Ana: I would go: fourteen hours divided by 1,106 and then come up with the answer and then write that down. But with the kilometers afterwards, per hour.

She went to the next problem and read it aloud in Spanish, but did not translate it into English.

El trombón de Tere le costó en total $345.80. Lo pagó en 52 pagos semanales. ¿Cuánto pagó cada semana?

'Tere's trombone cost $345.80. He paid it off in 52 weekly payments. How much did he pay each week?'

She then proceeded straight into solving the problem after having read it aloud in Spanish:

Yo me dividió [sic] cincuenta y dos por tres cientos cuarenta y cinco y ochenta centavos. Tengo - -la respuesta - - y esta abre la respuesta como así. I do the problem like that. I go fifty-two divided by three hundred and - -

Shirley: You do that in Spanish?

Angela: Yep.

Shirley: How would you say this part in Spanish? (345.80 ÷ 52)

Angela: **Tres cientos cuarenta y cinco dolores y ochenta centavos dividido por cincuenta y dos.**

Shirley: Son?

Angela: What? Son? You mean the answer?

Shirley: Yeah.

Angela: Well, I have to have a (chance to do it?).

What is seen in this case is that Ana (6M/M)solved the problem in English after having translated it into English and spontaneously began to solve the problem after reading the problem aloud in Spanish. What is interesting is that reading the Spanish aloud seems to have effectively prompted Spanish use. The researcher, not fluent in Spanish, was certainly not the prompt. The question is: Is there something special about reading instructions aloud in terms of the language subsequently chosen for processing? And more generally: How do verbal prompts affect the language chosen for processing? This is a crucial question, especially for research studies like this one in which verbal report techniques depend on verbal questioning.

It is interesting that Ana did not actually complete the whole problem in Spanish for the researcher. Rather, she only told the researcher what she would have done to complete the problem. However, this does not negate the fact that she switched into Spanish with a monolingual English speaker after reading the Spanish aloud.

c. Discuss Problems with Other Learners (Social Environment)

As mentioned above, learners also occasionally used Spanish to discuss task related activities with each other. In the following exchange in the sixth grade class, another learner was clarifying the instructions of the exercise with Halena (6H/H). They were working on a math sheet with the following instructions:

> **Escribe cada fracción como decimal como fracción. Luego usa tus respuestas para resolver el acertijo.**
>
> 'Write each decimal as a fraction. Use your responses to solve the puzzle.'

The problems were like this: ½ = (.5) or 3/20 = (.15) or .75 = (3/4). Each problem had a letter associated with it. At the bottom of the page, the punchline to a joke could be completed by solving the problems correctly and putting the letters associated with each answer in the puzzle correctly. While working on the problems, a learner approached Halena and asked her a question about the problem in Spanish. Halena responds to the question in Spanish as well.

Ex. 11 Other Learner: **Zero por zero - - aquí - - las letras.**

Halena: **Tienes la respuesta para éstos, si es** (data unrecoverable from tape)

hacer como - -

Other Learner: **¿Esto?**

Halena: **No, es punto - -**

Other Learner: **¡ Esto es para esto !**

Halena: **Por después por** (words unrecoverable from tape, in Spanish) **como esto es punto cinco, que va a hacer esto. Que es 'A'.**

2. English

Whereas some learners generally reported solving problems in Spanish, others reported that they generally solved problems in English. Todd (6M/M) said, "I usually think in English. It's . . . because it's just like that language that . . . I know the best." When I asked Cynthia (6L/L) what language she normally thought the answers in, she said English. About word problems, she said, " . . . we figure it out in English, so it would be better for us to understand." Of the seven instances of self-revelation data that were collected where individual learners were engaged in solving math problems, all but one were in English. In the other remaining instance, the learner processed a small portion in Spanish and the rest in English. The following examples illustrate situations where learners used English in problem-solving processes.

a. Cognitive Difficulty of the Problems

If problems were difficult for learners, learners tended to use English for the cognitive processes necessary to solve the problem. Whereas Ana (6M/M) said she could solve problems like 3 4/5 + 5 1/5 in Spanish, she said that with more difficult problems, like 40 1/2 - 17 9/16, she had to switch into English. She said, "It's hard for me to remember what number is up here and what number is down here [referring to converting the 1/2 of 40 1/2 to 8/16] and then since you can't take away 8 through 9 [referring to subtracting 9/16 from 8/16], then I get even more confused - - it gets really nuts."

Learners processed other problems that presented difficulties in English as well. Karen (6H/H) reported that she performed the following problems in English because they were difficult. Here are the instructions and some examples of the problems:

> Ex. 12 Instructions: **Pares de fracciones (Title)**
> **Usa los números del 1 al 8 para escribir dos fracciones con los productos y las sumas que se dan. Puedes usar cada dígito tantas veces como sea necesario 1-8.**
>
> 'Use the numbers from 1 to 8 to write two fractions that will give both the product and the sum. You can use each number from 1-8 as many times as necessary.'
>
> Problems:
> 1. **Producto**: 6/49 **Suma**: 5/7
> (Ans: 2/7 y 3/7)
>
> 3. **Producto**: 1/5 **Suma**: 9/10
> (Ans: 1/2 y 2/5)
>
> 4. **Producto**: 1/9 **Suma**: 5/6
> (Ans: 2/3 y 1/6)
>
> 7. **Producto**: 4/35 **Suma**: 27/35
> (Ans: 1/7 y 4/5)

I asked her if she was thinking in English or Spanish while doing these problems, and she said English, because the math was kind of hard. However, she said that when she was reading the directions, it just came in Spanish. She also mentioned that she had to translate the last sentence of the instructions for other learners, but that she had understood everything herself in Spanish.

b. Problems with Many Calculations

Learners also used English with problems that involved a lot of calculations. Karen (6H/H) was working on a problem from the previous day which she found difficult because of the relationships between the calculations she had to perform and the great number of calculations she had to do. She said that while she used Spanish with word problems, she used English with problems with lots of calculations.

Ex. 13 Karen: OK. Well, right here it, um, they say: if you have a million dollars and one is wasted every second, how long will it take? So far I have eleven days and thirteen hours, but I have to figure out the minutes and seconds. It's pretty hard. I'll probably minus nine hundred and fifty thousand - - four hundred - -

Researcher: Now, when you do normally do these, do you do them in English or in Spanish in your head?

Karen: Well, this one I do - - actually I usually do these hard ones in English. Because they're really difficult.

Researcher: I told her to use whichever language she would normally use.

Karen: Well, see this is not much of a problem - - they're giving you more numbers than they are words. See this one, the one we have today, is more words. So usually I'll do more Spanish with that. Like this is all numbers, that's a lot different.

Karen: - - divided by sixty - - eight times twenty-six minutes? Now, I'm confused.

c. Social Environment

Learners also reported using language based on their social environment. When I asked her what language she usually did her math problems in Karen (6H/H) said, "It depends upon the time of day and what the people around me are thinking, because I have them [words] memorized in both languages . . . it depends on what other people are speaking." She said that since she is "speaking English most of the day, her work just goes along with that."

d. Individual Differences

Sometimes the language learners used seemed to be due to individual differences. On asking Karen (6H/H) what language she solved geometry in, she said, "Aaah, that's hard. I usually go to English. It's not that the vocabulary's hard to understand - - but the whole project . . . it's kind of easier to think in English because it comes easier."

On the other hand, when I asked Ana (6M/M)what language she did geometry in, she reported processing in Spanish.

Ex. 14 Researcher: When you're doing your math . . . are you doing this in a language?

Ana: Usually I do it in Spanish.

Researcher: Could you show me what you do when you think about it in Spanish?

Ana: **Fué para el número que, como, um, que dan(?) saber cual(?) son dos lineas paralelas - - como así y así.** So, **hago las letras, effe(F) y a(A) y ge(G) y ele(L). Y no sé dónde está, mi FA y HL porque - - pero,** um, **sólo tienes que ver las letras y ver si son,** um, **perpendiculares. Hay esa y esa, esa y esa como - - como era, co - - esa y - - esa. Esa, eso. EA. HL.** It's easy when you think about it, but when you're actually doing it, it's a little harder.

3. Spanish to English

Learners sometimes began processing in Spanish and then switched into English, as happened with Peter (5M/M) in this case. Peter (5M/M) was working on the following problem on a math test. The question referred back to some information on a graph.

Ex. 15 **Teri usó la computadora 3 veces más minutos que Sue. ¿Cuánto tiempo trabajó Teri con la computadora?**

'Teri used the computer three times as many minutes more than Sue. How many minutes did Teri use the computer?'

Peter: OK. Now I think this one might be plus. (He read the problem aloud in Spanish, then continued). **Sue esta aquí, cincuenta y cuatro, uno dos tres - - cincuenta** [pause] OK. **¿Cuánto tiempo** - - How many minutes. Three times many minutes than Sue - - WHOA. OK. Fifty-four times three.

He then set up the problem like this:

$$\begin{array}{r} 54 \\ \underline{\times\ 3} \\ 162 \end{array}$$

Researcher: Asked Peter about what he was thinking before he went OK

Peter: I was thinking that Sue, right there, fifty-four; it [the problem] says three times more than Sue. So, three times four, twelve. Three times five, fifteen six. A hundred and sixty-two.

Although Peter (5M/M) made his original hypothesis about the problem in English, after reading the problem aloud in Spanish he began processing in Spanish. However, he seemed to run into trouble, probably because the problem required multiplication and not addition, as he originally thought. After he ran into a problem, he switched back into English; only after he

translated the problem into English was he able to see that the problem required multiplication, which he then completed in English.

4. English to Spanish

Learners switched not only from Spanish to English but also from English to Spanish. They seemed to switch into Spanish to refer to ideas of the problem that may have been best expressed in Spanish, as in the following case, where there was no good direct translation for the particular usage of the word **monedas** 'coin, token' in the following problem:

> Ex. 16 Math Problem (transcribed from oral data): **Luis y Raquel estaban jugando un juego. Al final de cada juego, el perdedor de (some word for 'gives' (?) ; unclear on tape) una moneda al ganador. Al final de una hora, Raquel la - - ha ganadó tres juegos y Luis tiene tres monedas más que al comienzo. ¿Cuántos juegos jugaron Luis y Raquel?**
>
> 'Luis and Raquel were playing a game. At the end of each game, the loser of the game (gave?) the winner a token. At the end of an hour, Raquel had won three games, and Luis had three tokens more than he started with. How many games did Luis and Raquel play?'
>
> Researcher: How did you figure it out?
>
> Carl: It says, two kids were playing a game, and at the finish of each game, the loser gave the other person, like 10 cents or something, a coin.
>
> Researcher: You can talk Spanish to me too.
>
> Carl: OK. I'll just keep - - [going in English]. And at the end of the hour, um, Raquel won three games and Luis **tiene tres monedas** (starts laughing), and Luis had three coins more than he started with. And then it says, how many games did they play? Well I thought: he had three left, right? And he had three more than he started, so. If he lost three times, then he had to give him three more coins; so three plus three is six. And then the other guy won three games, so it was three - - nine games they played.

This switch was interesting because Carl automatically and unthinkingly used the Spanish words **tiene tres monedas** 'had three tokens' to refer to concepts in the problem despite the fact that that he was breaking a sociolinguistic rule to speak Spanish to an English speaker and that he had explicitly rejected the researcher's prompt to explain the problem in Spanish . The fact that this use of Spanish was unusual was also indicated by the fact that he laughed out of uncomfortableness.

Todd, a learner who solved numerical problems in English, also used Spanish to refer back to important ideas in a word problem. He was working on the same problem as Carl, above.

Explaining how he did the problem to me, he said:

> Ex. 17 . . . **una juego a final de cada juego** - - one, that's where, you know, you say, one game at the end of each game - -when you won a game you got a, like a coin or something, you know, to see who got the most coins. They played for one hour. And then Raquel won, OK - -**tres juegos** - - that's three games. And, yeah, three games. So it says here,'**Luis tiene tres monedas más que al comenzar**', so she had three more up here; so you just gotta times three by three, and then she had three already, so you'd want to put in the games up here. So it's three times three - - nine - - three plus three plus three.

Todd indicated that he had originally solved the problem in Spanish; again, what is interesting here is that he refers back to the Spanish for the key ideas of the problem. Learners seemed to use both languages to solve problems in; however, they seemed to use English much more than they used Spanish.

5. Language of the Investigator

As Jim Parker and I worked in the same classrooms, we occasionally interviewed the same learners. As a result, we were able to collect a small amount of data relating to the effect of the language of prompting used by the investigator. Since I have very little experience in Spanish, I always prompted in English. However, Jim was also able to prompt in Spanish when the situation called for it. In the following instances, we both interview the same learner while she solves a math problem, using different languages for prompting.

a. Investigator Used English Prompts Only

> Ex. 18 Marina was working on the following problem:
>
> **Verónica quiere ahorrar para comprar un equipo estereofónico de $470. El año pasado ahorró $198.50 y este año, $123.99. También ahorró los $45 que ganó en un concurso. ¿Cuánto más tendrá ella que ahorrar?**
>
> 'Veronica wants to save in order to buy a piece of stereo equipment that costs $470. During the past year she saved $198.50 and this year she saved $123.99. She also saved $45 that she won in a contest. How much more does she need to save?'

Marina: She asked me if she should talk in Spanish or English, and I said to talk in whatever language she would normally talk in. . . .

Zero plus eight is eight - - five plus five is fourteen plus zero - - fourteen. One plus eight is nine plus three is twelve plus five is seventeen - - one plus five is ten - - plus two is eighteen plus four - - twenty-two. Two plus one is three plus one is four - -

Researcher: What are you doing there?

Marina: First I have to plus these and then I have to take away the answer from this, and I'm doing that right now.

Researcher: You can keep talking - -

Marina: Take-away nine - - nine take-away four is five, nine take-away seven is two - - six take-away two is four. Four take-away (?) - -

Clearly, the language here is English.

Then, she went on to the next problem. (See Graph and Problems next page).

She set up the problem in this way:

$$\begin{array}{r} 101 \\ 54 \\ 82 \\ \underline{+\,63} \\ 300 \end{array}$$

She continued working:

Marina: One plus four is five, five plus two is seven, seven plus three is ten. One plus zero is one, one plus five is six, six plus eight is fourteen, fourteen plus six is twenty. Two plus one is three.

Here's how Marina set the problem up: $300 \div 4$

Marina: Four goes into thirty seven times. Seven times four is twenty-eight. Thirty take-away twenty-eight is two. Drop the zero. Four goes into twenty five times. Five times four is twenty.

Clearly, the language Marina used was English. It is important to note that she may have been affected by the researcher's presence, as she asked me which language she should use.

b. Bilingual Investigator

In this instance, the researcher (Jim Parker) who collected this data used a fair amount of Spanish throughout the collection process.

Ex. 19 Marina was working on math problems copied in her notebook. I sat down to observe her for awhile.

Researcher: **¿Cuándo haces las matemáticas, la voz en su mente, es Ingles o Español?**

'When you do your math, is the voice in your head in English or Spanish?

Marina: **Los dos.**

'Both.'

Researcher: Can you work this one out loud for me in Spanish?

Marina: Okay. [Marina began to write while she spoke]. **Cinco va en cinco un vez. Uno por cinco es cinco. Cinco por cinco es veinticinco. Cinco va en veinticinco cinco veces. Veinte** - WAIT! [Erased mark on paper]. **Cinco va en cinco un vez. Uno por cinco es cinco. Cinco menos cinco es zero.** [Carried down the 5 with pencil]. **Cinco va en cinco un vez. Cinco por uno es cinco.** [Completed the subtraction]. THERE!

'Okay. Five goes into five one time. One times five is five. Five times five is twenty-five. Five goes into twenty-five five times. Twenty - -WAIT! Five goes into five one time. One times five is five. Five minus five is zero. Five goes into five one time. Five times one is five. THERE!'

It seems clear in this case that while Marina was able to process the numbers in Spanish, when she ran into a problem she still used English, even when she had been explicitly asked to use Spanish.

Ex. 20 Marina continued to work on problems from her notebook.

Researcher: **¿Y la próxima?**

'And the next one?'

Marina: **Dos va en ocho cuatro veces. Cuatro por dos es ocho. Ocho - -** [Marina paused 14 seconds as measured against the tape]. **Ocho menos ocho es zero. Dos va en cuarenta - - veinte veces.** [Pause; 12 seconds. Marina began again from the top tracing the problem steps with her pencil.] **Dos va en ocho cuatro veces. Cuatro por dos es ocho. Dos por dos es cuatro. Veinte cuatro.**

'Two goes into eight four times. Four times two is eight. Eight - - eight minus eight is zero. Two goes into forty - - twenty times. Two goes into eight four times. Four times two is eight. Two times two is four. Twenty-four.'

Jim replayed the tape for Marina and asked her some questions about the pauses.

Researcher: You said ocho and then you faded off. What were you doing there?

Marina: Trying to think.

Researcher: What were you thinking?

Marina: I was thinking, "Wait a minute!"

Researcher: Did you try to rework the problem?

Marina: Yes.

Researcher: Were you using a language or just numbers?

Marina: Language.

Researcher: What language?

Marina: English.

The researcher played the tape of the problem back one more time.

Researcher: What happened there [during a pause]?

Marina: I was thinking again.

Researcher: Were you also using language?

Marina: Yeah, English.

When Marina finished with her problems, the researcher asked several more questions.

Researcher: Do you need to translate to solve these problems?

Marina: Sometimes.

Researcher: If you could describe when the voice in your head changes from Spanish to English, when would that be?

Marina: When they get harder.

Researcher: The math problems.

Marina: Yeah.

In this case, Marina switched into English when she ran into a problem with the math problem. In comparing these examples, we see several interesting things. It is clear that Marina can solve problems in Spanish and English. When she is prompted to do the work in English, she

can, and when she is prompted in Spanish, she can also do the work in Spanish. However, it is also clear from the interview with the bilingual investigator that Marina switched into Spanish when she reached a difficult point in the problem. This switch was clearly related to the problem itself and not the language of prompt of the investigator.

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DISCUSSION

The results of this study suggest several interesting things about the language use of learners both as they communicate with their teachers and with other students, in other words, communication in the external language environment and as they work on academic tasks, that is, the language used in the cognitive processing of academic tasks.

A. Language Use in the Classroom - "Spanish for Special Purposes"

Both non-participant observation data and learner self-report data suggest that students used Spanish when talking to the teacher in a teacher-fronted classroom situation. In a teacher-fronted situation learners probably felt pressure, from the teacher and from their peers, to conform to the "Spanish only" rule of the immersion program. However, this situation changed when students were talking amongst themselves. In a situation where students addressed each other, whether non-teacher-fronted or teacher-fronted, the language tended to be English, unless students were working on an academic task. If students were working on an academic task together, they used Spanish sometimes. Students seemed to use Spanish only when working on academic tasks and not for social purposes.

To explain this phenomenon, Elaine Tarone has suggested that learners in an immersion program may be learning an academic Spanish, a "Spanish for Special Purposes"[11], since the pressure to produce Spanish occurs only around academic tasks (personal communication, 1993). She has suggested that learners may not develop an adequate set of social language skills in the target language because they receive little social language input and little opportunity to practice social conversation within the academic context of an immersion program. That is, since most of the input that learners receive in Spanish and most the output that learners are forced to produce in Spanish revolve around academic topics, learners may develop only an academic Spanish. As a result, learners may lack the motivation or skills to discuss social events in Spanish; learners

[11] Many thanks to Elaine Tarone for this explanation as to why learners seem to use Spanish exclusively for academic purposes.

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may find it difficult to discuss a television program like 'Deep Space Nine' in Spanish because they lack the vocabulary or because they lack practice in discussing such issues in Spanish.[12] Learners may lack the precision of expression that they find in English (i.e. they may not know how to say things like, "neat", "cool", "awesome", etc. in Spanish) and thus may prefer to express these ideas in English (Elaine Tarone, personal communication, 1993).

Ironically, this finding on immersion students, the "haves", contrasts with J. Cummins (1991) findings on bilingual education students, the "have nots". While the findings on immersion students showed that immersion students fared better with academic language proficiency, Cummins found that NNS minority students in U.S. classrooms would do alright in conversational language proficiency but not in academic language proficiency.

While the results of this study present only an initial view into the language used in the classroom, it is clear that it is necessary to have an understanding of the language that students and teachers choose to use with each other across a variety of situations in order to be able to understand the language learning processes in an immersion program. A larger empirical study that would more extensively document language use patterns in the classroom could provide further insights into the motivations for language use in the classroom and shed light on the language acquistion process in immersion education.

B. The Language of Cognitive Throught During the Comprehension and Production Aspects of Academic Tasks

In general learners were able to understand written and verbal instructions in Spanish, especially if these instructions were over material learners easily grasped, for example, familiar procedures or routine numerical problems. This finding is consistent with previous research on immersion learners which suggested that immersion learners' comprehension skills are quite good [Genesee 1987]. However, learners had more difficulty understanding instructions in Spanish if the material was new or difficult for any reason, including unfamiliar vocabulary and

[12] See Parker, J. 1994. "The Role of the Native and Target Languages in Performing Academic Tasks in an Immersion Classroom". Unpublished senior thesis. University of Minnesota: Minneapolis, MN.

cognitive difficulty, or if the teacher spoke too rapidly. Although Karen, a student rated high both in academic performance and Spanish proficiency, used a strategy that allowed her to stay in Spanish when she ran into difficulty with unfamiliar vocabulary (Ex. 5), other learners' responses to unfamiliar or difficult material seemed to be to switch into English to understand the instructions (Peter, Ex. 7), either by translating literally (Alberto, Ex. 8) or by figuring out the logic of the problem (Ana, Ex. 6). This seemed to be particularly true of word problems, where learners have to map linguistic structures onto the conceptual knowledge structures of numeric principles (Cummins, D.D., Kintsch, Reusser, & Weimer 1988).

Learners oftentimes seemed to perform much of the cognitive processing of problems in English (Todd, p. 34; Cynthia, p. 35; Peter, Ex.15; Marina, Exs. 18-20). If learners began processing problems in Spanish, they tended to switch over into English if they ran into any difficulty (Todd, p. 27; Peter, Ex. 15). With word problems, learners sometimes used Spanish to refer back to essential ideas of the problem, but seemed to do much of the planning for the problem in English (Donna, Ex. 9, Todd, Ex. 17). Learners across a spectrum of abilities seemed to use English in difficult situations (Karen, Ex. 12-13; Alberto Ex. 8), although what was difficult or caused the learner to switch into English depended on the abilities of the individual learner (Karen, p. 37; Ana, Ex. 14). It seemed that learners with lower academic and Spanish ability rating tended to do most of their work in English, whereas learners of higher ability seemed to process to a greater extent in Spanish. However, even high-ability learners seemed to use English to a large extent. Learners seemed to use Spanish mainly to refer back to the problem and seemed to use English when they ran into any difficulty during the comprehension and production aspects of solving math problems.

C. Limitations

1. Learner Language Use in the Classroom

One of the most problematic aspects of this study is the fact that I was not a speaker of Spanish. It could be very convincingly argued that just the presence of a non-Spanish speaker in an immersion classroom might affect the language that learners and the teachers use, even the

presence of a researcher who the class is quite used to. In addition, I did not make an exhaustive count of each use of Spanish or English that I heard. There were countless instances of English that I was not able to record and I am sure I missed hearing instances of Spanish.

However, despite the fact that this is only an initial glimpse into the language that is used in immersion classrooms, it seems to me that it is an important starting point. The fact that learners seem to use Spanish only in relationship to academic tasks may help explain Lambert and Tucker's (1972) findings that while immersion students performed at near-native levels on academic tasks in the target language, they still had problems communicating with a native speaker of the target language who was at the same age level. It might be interesting to further study the extent to which students have the opportunity to practice social discourse in the target language, in order to be able to suggest new strategies to encourage more extensive language production in immersion programs.

2. The Language of Cognitive Processing

From the outset of the study, it was clear that the language used to prompt learners in verbal report protocols was crucial. However, there was little research speaking to the point of what effect the language of prompt would have on verbal report protocols. At that time we saw several obvious advantages to using English; however, there were also several compelling disadvantages.

a. Advantages of English-speaking Investigator

There were several advantages to using English to prompt students. It was felt learners might feel more comfortable reporting in their native language and that they might be able to express themselves more fully in the native language. It was also felt that learners would feel less intimidated by verbal report protocols if they knew they could report in their language of choice. I felt that allowing the learners to report in English allowed me to develop a rapport with them that I might not have been able to develop if they had been required to report exclusively in the target language. I also felt that they could express themselves freely and that they could trust me because they were able to report in the native language.

b. Disadvantages of English-speaking Investigator

However, there were also several obvious problems with using the native language as the main language of verbal report. The most obvious disadvantage was that an English prompt, especially from a researcher not fluent in Spanish, might discourage a learner from thinking-aloud in Spanish or it might even prompt the use of English. I tried to mitigate this factor by reminding students that they could use whatever language felt most comfortable, and if I did not catch something I could recover it from the tape later.

How successful these measures were or could have been is not clear. However, despite the fact that learners had an essentially monolingual English relationship with me, there were still times when they used Spanish. One learner even used Spanish even after he indicated that he did not feel it was appropriate to use Spanish with me, as we see in Ex. 16. In this case, Carl said that he would rather use English even after I reminded him that he could use either language with me. This comment only makes his subsequent use of Spanish (**tiene tres monedas**) all the more interesting. It might indicate that some concepts, especially key phrases in problems, may be processed directly in Spanish.

Although within the scope of this pilot study it was difficult to gather much data on the effect of the language of prompting, there was one interesting instance that may be related to this question. In comparing Ex. 18-20, we notice that with English prompting Marina externalizes only in English and with Spanish prompting she externalizes in Spanish, in both situations she seems to use English to plan the problem or if she runs into a difficulty. Thus, although she externalizes in English with the English prompt and in Spanish with a Spanish prompt, it seemed that she was doing at least part of the processing in English in both cases.

The question that remains to be answered is: How much does the language of the investigator influence the language of verbal report? And how much does it affect the language of processing? Clearly, these questions will require more study. It would be interesting to duplicate this study with investigators who were proficient bilinguals to see if similar results would be obtained or if the amount of Spanish elicited would be higher.

D. Conclusion

This preliminary research suggests that it would appear that learners may not be as immersed in the target language as educators, administrators, and teachers would hope their students to be. Although learners do use Spanish to communicate with teachers and other learners, especially when talking to the teacher in a teacher-fronted situation or if they are working on an academic task, they also seem to use English a great deal. Learners seem to use English when they are working with other students. If learners are working alone, they tend to use English in cognitive processing if they find the work difficult for any number of reasons. Clearly, more research remains to be done in this area, in order to gain a clearer picture of what language learners do select in a given situation and for what reason, both during the cognitive processing of classroom tasks and in communicating with fellow learners and teachers.

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